

Accident Summary: Failure of High-pressure Vessel

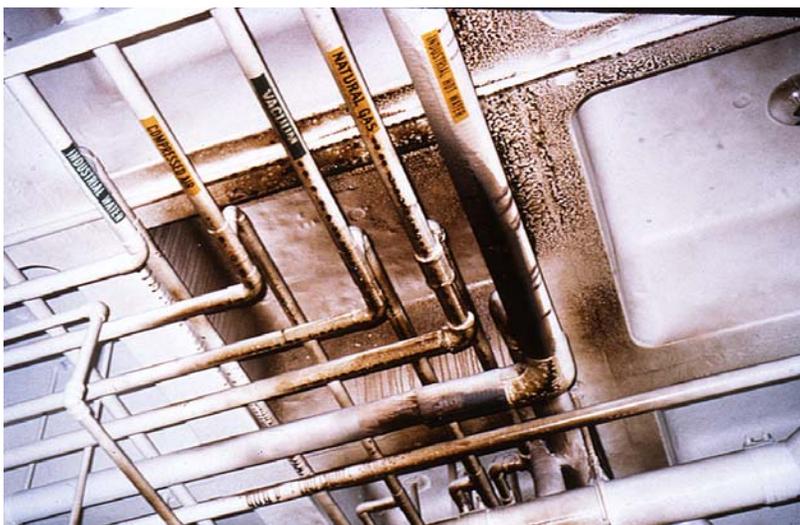
A research lab was conducting experiments within a high-pressure/high-temperature reactor, or autoclave. The reaction mixture was placed into the sealed reactor and the heating system was engaged. Unfortunately, the thermostat which measured and controlled the final temperature malfunctioned leaving the heating elements in a constantly-on mode. Therefore, the temperature and internal pressure of the reactor continued to build unabated. Eventually the pressure reached the point where the built-in over-pressurization safety valve came in to play. Within high-pressure reaction vessels from vendors is a so-called “frangible disk” that is designed to fail at a given pressure, thus preventing the whole reactor from becoming an extremely dangerous pressure bomb. The hot reaction mixture was forcibly vented through the valve which is seen on the upper left part of the reactor. The materials were sprayed upward with enough force to hit the lab ceiling as shown below. Fortunately, no one was in the immediate vicinity of the reactor, since serious injury would certainly have occurred.

Lessons Learned: It is unknown if routine testing and maintenance of the temperature controller would have identified the problem. Any piece of equipment has a limited lifetime and must be routinely examined and tested to verify that all safety features are intact and functional. The owner’s manual for such a potentially dangerous piece of equipment must be reviewed routinely regarding any required maintenance/testing, or life-expectancy limitations. For any pressure vessel, a log book must be maintained that records the conditions of each run, particularly the accumulated time the vessel has been in use, plus any maintenance/testing performed. Ideally, any high-pressure vessel should only be run in an area which is away from personnel, or, at minimum, well-shielded from individuals. A fuller discussion of safety issues with high-pressure vessels can be found in *Prudent Practices in the Laboratory* by the National Research Council:

<http://fermat.nap.edu/books/0309052297/html/124.html>



High-pressure and high-temperature reactor. Note pressure gauge and over-pressurization relief valves equipped with frangible disk.



Ceiling of lab coated with reaction mixture after release through over-pressurization safety relief valve